AN ANALYSIS OF FEED COSTS IN PRODUCING MILK IN NORTHEASTERN OHIO

A thesis

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by

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CHAPTER I

INTRODUCTION

HISTORY

Dairying is the most important farm income producing enterprise in Ohio. In 1964 sales of dairy products comprised twenty percent of the total farm income for the state. Dairying is the leading source of farm income in forty-two counties and is the second source of income in nineteen counties.[1]

The dairy cow and the production of milk has been an important part of the northeastern Ohio farm economy since the early days of settlement. In pioneer days milk producing cows were kept to provide milk and cheese for family consumption. Surplus milk was fed to pigs, calves, or other livestock. Usually the number of cows kept on a farm was dictated by the needs of the farm family.

Most of the milk was produced during the spring and summer months. The cows were usually dry during the winter. Blue grass pasture was abundant in the spring and grew sparse toward late summer. Milk production declined as the season progressed.

The winter feed consisted of corn fodder, low quality hay, (predominantly grass) and straw. Many farmers used a ration composed entirely of pastures and dry forage; little grain was fed.

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[1] 1964 Ohio Farm Income, Estimated Cash Receipts Farm Marketing and Government Payments By County and Major Commodity Group, Department Series AE. 388, Ohio Research and Development Center, Wooster, Ohio, October 1965, p. 8

Facilities provided for the dairy cow consisted of a box stall in the barn and nearby pasture area. Milking was done in a pail with the cow standing in the field or tied in the barn.

In contrast to the pioneer farm of yesteryear, the modern dairy farm is operated much like a factory. Milk is produced for fluid market consumption. Some farm families purchase milk and most purchase all of the other dairy products consumed. The production of milk is a 12 month activity with the volume being nearly uniform during each of the 12 months. This has been accomplished by providing high quality feeds for the winter period, the use of grains and supplements for nutrient balance, and balanced breeding programs.

Dairy production facilities today resemble factories featuring gleaming milking parlors equipped with stainless steel and glass milking, transfer, cooling, and storage equipment. Feeding is handled automatically. "Labor saving" is the watchword. As a consequence, herds of 40 to 100 cows are commonplace.

Modern dairy farms make use of improved technology in fertilization, plant breeding, harvesting, storage, and handling to produce high crop yields which are necessary for milk production.

Looking to the future we can expect further changes to take place in housing,equipment, feeding, production techniques, and continued increase in herd size. Predictions are that the dairy enterprise will become even more specialized than it is today. This will mean larger herds, housing that can handle cows more efficiently, equipment that will speed up the milking process, improved feed production and

feeding practices, and more specialization in the production activities. Some units will handle the milking herd and others the production of replacement stock.

OHIO TRENDS

Dairy cow numbers peaked in Ohio during the decade of the 1940's with 1,076,000 head and has since declined to 677,100 head in 1965. (Table 1).

The number of farms has followed a similar trend. In 1940 there were 233,783 farms in Ohio and has declined to 140,353 in 1960. (Table 2). Current estimates are that the decrease is at the rate of 3 percent per year.[2]

As absolute cow numbers have decreased the number of dairy cows has been increasing on the farms with a dairy enterprise. (Tables 3 and 4).

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[2] Estimates made by the Department of Agricultural Economics and Rural Sociology, The Ohio State University.

TABLE 1
MILK COWS AND HEIFERS ON FARMS: SELECTED OHIO COUNTIES
FOR 10 YEAR PERIODS AND 1965

County	1930-1939	1940-1949	1950-1959	1965
Holmes	13,610	16,090	18,000	17,600
Ashland	10,750	11,700	12,910	12,600
Wayne	23,140	26,460	30,950	30,800
Medina	15,530	17,350	17,730	13,900
Summit	8,333	7,830	4,940	1,800
Stark	19,680	21,780	20,370	15,500
Lorain	16,580	17,610	15,790	12,200
Total	107,620	118,820	123,690	108,100
State	1,019,400	1,076,000	929,000	677,100

Source: Let's Take A Look At Our County And State, Reference Data, 1930-1960, Ohio Agricultural Extension Service, College of Agriculture, The Ohio State University, p. 33.

TABLE 2
NUMBER OF FARMS AND FARM SIZE SELECTED OHIO COUNTIES AND STATE
1930, 1940, 1950, 1960

County	1930		1940		1950		1960	
	No. Farms	Acres Per Farm	No. Farms	Acres Per Farm	No. Farms	Acres Per Farm	No. Farms	Acres Per Farm
Holmes	2,249	108	2,286	108	2,122	114	1,919	116
Ashland	2,143	109	2,336	104	2,097	110	1,676	128
Wayne	3,661	88	3,776	88	3,288	97	2,655	113
Medina	2,674	84	3,126	75	2,628	84	1,677	104
Summit	1,579	80	2,986	45	2,469	4	707	71
Stark	3,435	76	4,701	60	3,887	66	2,283	89
Lorain	3,038	79	3,423	73	2,875	81	1.929	100
Total	18,779	98	22,640	76	19,366	83	12,846	107
State	219,296	98	233,783	94	199,359[a]	105	140,353	132

[a]change in difination of farm was made for 1949 Census

Source: Let's Take A Look At Our County And State, Reference Data, 1930-1960, Ohio Agricultural Extension Service, College of Agriculture, The Ohio State University, p. 13.

TABLE 3
OHIO FARMS REPORTING MILK COWS,
BY NUMBER ON HAND, U. S. CENSUS
DATA, NUMBER AND PERCENT

Herd Size	1950		1959	
	No. Herds	Percent	No. Herds	Percent
1 - 9	11,574	79.6	42,448	63.4
10 - 19	24,365	17.1	14,473	21.6
20 - 49	4,477	3.1	9,301	13.9
50 - 74	121	.08	616	.9
75 - 99	20	.01	137	.2
100 +	27	.01	40	.06

Source: Comprehensive Research Review, Department of Dairy Science, The Ohio State University, May 24-26, 1965, p. 10.

TABLE 4
COWS BY VARIOUS HERD SIZES, ESTIMATED NUMBER
OF COWS AND PERCENT BY CENSUS YEARS 1950-1959

Herd Size	1950		1959	
	No. Cows	Percent	No. Cows	Percent
1 - 9	452,825	49.6	158,755	23.0
10 - 19	323,810	35.5	201,876	29.3
20 - 49	123,397	13.6	272,125	39.5
50 - 74	7,502	.8	38,192	5.5
75 - 99	1,740	.12	11,919	1.7
100 +	3,780	.4	5,600	.8

Source: Comprehensive Research Review, Department of Dairy Science, The Ohio State University, May 24-26, p. 11.

TABLE 5
VALUE OF DAIRY PRODUCTS SOLD IN SELECTED OHIO COUNTIES
1940 - 1955 - 1960 - 1965
RANK OF COUNTIES IN STATE
IN DAIRY INCOME - 1965

County	1940 (000 Dol.)	1955 (000 Dol.)	1960 (000 Dol.)	1964 (000 Dol.)	Rank In State
Total	$7,538	$25,128	$30,602	$42,286	
Holmes	$ 741	$ 3,204	$ 4,120	$ 5,588	5
Ashland	$ 563	$ 2,416	$ 3,581	$ 5,380	7
Wayne	$1,544	$ 7,068	$ 8,772	$12,819	1
Medina	$1,219	$ 4,115	$ 4,578	$ 6,047	4
Summit	$ 698	$ 842	$ 686	$ 782	-
Stark	$1,390	$ 4,232	$ 5,191	$ 6,600	3
Lorain	$1,401	$ 3,252	$ 3,675	$ 5,070	8
State	$51,949	$149,101	$166,921	$216,670	

Source: Let's Take A Look At Our County And State, Reference Data, 1930-1960, Ohio Agricultural Extension Service, College of Agriculture, The Ohio State University, p. 29.
1964 Ohio Farm Income, Estimated Cash Receipts From Farm Marketings and Government Payments by County and Major Commodity Groups, Department Series AE. 388, Ohio Research & Development Center, Wooster, Ohio, Nov. 1965, pp. 14, 16.

Milk production per cow has increased in Ohio from 4,369 pounds per cow in 1965. Extrapolation of trends in cow numbers and milk production per cow through 1970 indicates a production of 10,000 pounds of milk per cow and from 485,000 head of dairy cows.[3] Similar trends have been observed in other areas of the United States.

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[3]Robert Jacobson, The Milk Marketing Situation and Its Meaning to Cooperatives in Central and Southeastern Ohio, Department of Agricultural Economics and Rural Sociology, The Ohio State University, November, 1965, p. 9

THE STUDY AREA

Several factors contribute to the concentration of commercial dairy farm production in Northeastern Ohio: the suitability of soils and climate for the production of forage crops which are the major feeds for dairy cows; favorabile yields of grain crops (Table 6); proximity to major markets for fluid milk; and milk production skills of the dairymen.

The specific geographic area included in this investigation consists of seven Northeastern Ohio Counties - Ashland, Holmes, Lorain, Medina, Stark, Summit, and Wayne. (Figure 1). These counties form the area serviced by the Ohio Cooperative Extension Service. This seven county area is similar in many respects to much of Northeastern Ohio and part of the adjoining areas to the east.

The general character and trends in the milk production industry of this area have been similar to that found in the rest of Ohio. (Table 1). However, this area is gaining in relative importance to the dairy industry of Ohio as an intensive production area.

In 1964 the seven county area contained 16 percent of the cows and produced 20 percent of the total dairy income of the state. (Tables 1 and 5).

Dairying is the leading farm income producing enterprise on farms of the seven county area being first in five of the counties and second in two of the counties. Sales of dairy products represent 38 percent of the total farm income of the area. The success of the dairy enterprise is of vital importance to the farmers located in the seven county area and to the economy of which it is a part.

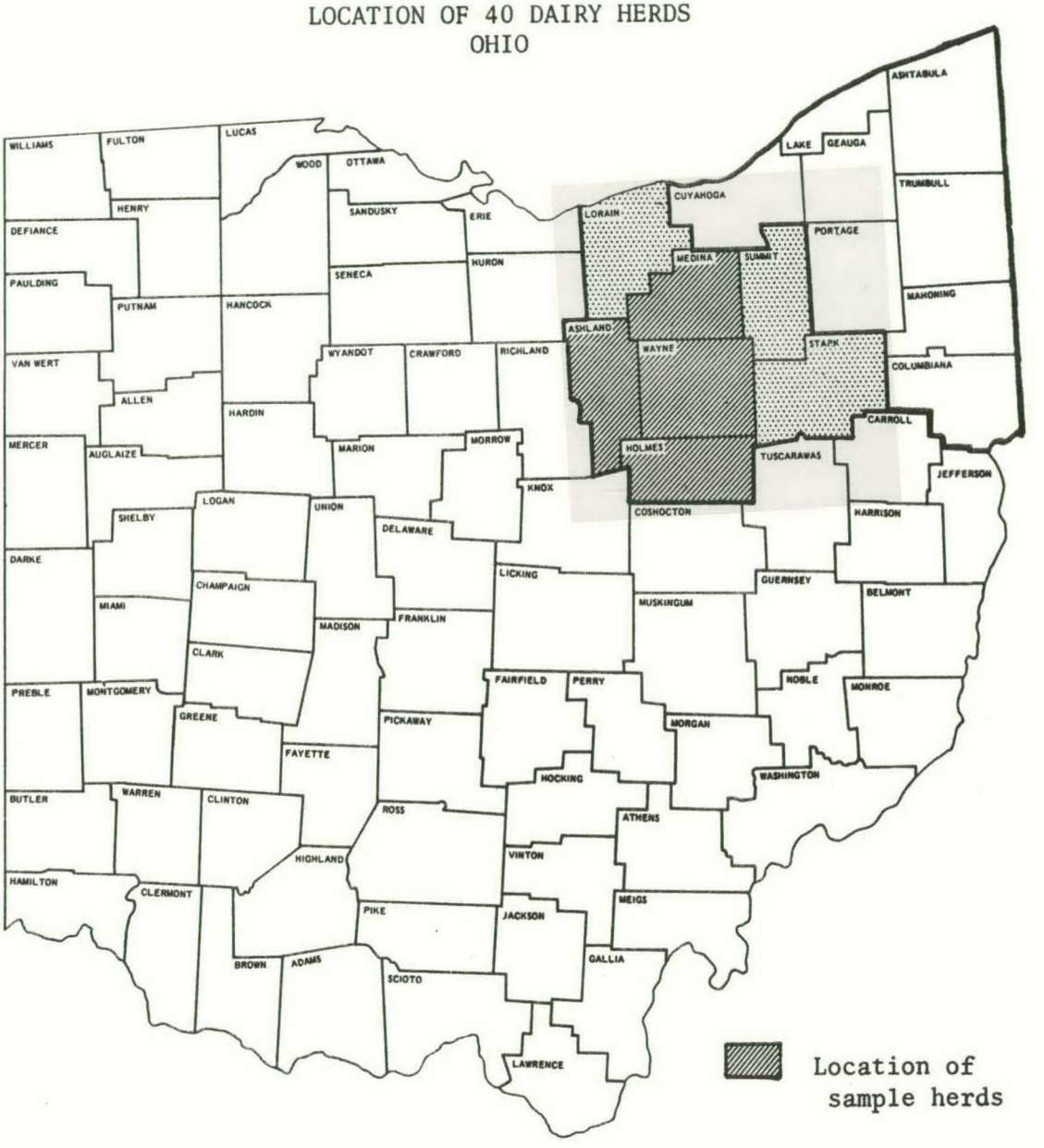
TABLE 6
CORN FOR GRAIN AND ALL HAY, ESTIMATED PER ACRE YIELDS
SELECTED OHIO COUNTIES AND STATE
FIVE YEAR AVERAGE 1960 to 1964

County	Hay (Tons)	Corn (Bu.)
Holmes	2.09	77
Ashland	2.06	74
Wayne	2.30	81
Medina	2.09	74
Summit	1.82	63
Stark	2.04	66
Lorain	2.16	72
Average	2.13	75
Ohio	1.82	65

Source: Ohio Agricultural Statistics, Annual Report, Major Crops and Lisestock, Ohio Crop Reporting Service, 1962, 1963, 1964, 1965, p. 18

FIGURE I

LOCATION OF 40 DAIRY HERDS
OHIO



COST COMPONENTS

Maintaining or increasing dairy profit must be accomplished if Northeastern Ohio farmers are to compete in the future with other milk producing geographic areas as well as with other farm production activities. Profits from the dairy enterprise depends on the relationship between revenue from the sale of dairy products and cost of production.

As the dairy enterprise has become more highly commercialized and specialized the dairymen is dependent on this single source of income. As a result he must be increasingly diligent in judging production costs as well as maintaining yields. Mistakes are intolerable and result in the operator being forced out of production.

The increase scale of the dairy operation leads to more complex and varied problems than were encountered by the pioneer dairyman. Less individual attention can be given to each cow although more diligent care is essential for the attainment of potential production at an efficient cost. Feed production, harvesting, storage, and feeding take on a major importance as a part of the total milk production picture on the dairy farm. The dairy barn equipment is complex and expensive. Add to this the facts that the costs of many of the factors of production are increasing and that the individual farmer has little influence of product price, it becomes clear that production costs must be carefully controlled.

Methods of handling cows have changed greatly over the years and

have affected the feeding operation.

Loose housing and comfort stall systems have replaced the stanchion system of housing the dairy cow. Recently the loose housing sytem has been modified with the use of free stalls. These changes have compelled dairymen to use mass feeding systems which reduce the amount of individual attention each cow gets.

The milking job has been switched from hand milking to machine milking. Most of the larger dairymen use the elevated milking parlors which presents a concentrate feeding problem in that the cows are in the parlor for such a short time that they may not have enough time to eat the grain.

Feed constitutes approximately half of the total cost of producing milk.

Feed costs are affected by the amount of feed fed, the proportion actually consumed, the relative cost of the various feed ingredents, and the combination used in the ration. The production response depends on the production ability of the cow, the nutrient balance of the feeds, the quality of the feed, the amount of feed consumer, the health of the cow, and the general care and handling of the herd. The feed costs per hundred weight of milk produced then depends on the response of the cow to the particular feeds fed and their costs.

Milk production costs are also important to the consumer. Long-run economic considerations dictate that milk prices will reflect the cost of production. With feed making up the major portion of the cost of producing milk these feed costs are significant in affecting the profits of the dairymen and in the price of milk to the consumer.

A primary concern of the dairymen is the cost of producing milk as influenced by the feed component.

PROBLEM DELINEATION

Farm account record summaries from Ashland, Holmes, Medina, and Wayne Counties indicate that average milk production costs were greater than returns.[4] Since feed costs make up such a large proportion of total production costs, it is possible that economies in feed-milk-transformations can modify the cost return relationship. These economies may be accomplished in several aspects of the dairy feed program - (feed production[5], harvest, storage, feeding). All offer possible reduction in milk costs.

An analysis of 95 dairy farms in 1962 revealed that average purchased feed costs were $121 per cow on an entire herd basis (including young stock). This feed cost was received in addition to feeds produced on the farm. These farmers used an average of four acres of land per cow.

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[4]Ashland-Holmes-Medina-Wayne, Farm Business Analysis Report, 117 Farms, 1962, Marshall K. Whisler, Area Extension Agent, Farm Management.

Ashland-Holmes-Medina-Wayne, Farm Business Analysis Report, 128 Farms, 1963, Marshall K. Whisler, Area Extension Agent, Farm Management.

[5]A 1963 study of 140 farms in the four county area mentioned on crop production shows this to be one of the problem areas. The potential TDN production was computed and compared with actual production in each farm. The potential production was based on the (1) yield potential of the soil, (2) use of the latest production and fertility practices, and miximum crop intensity permissable under soil conditions on the farm, and (3) crop nutrient value. On the average, the farms were producing 75 percent of their potential. (Marshall K. Whisler, Area Extension Agent, Farm Management, Wooster, Ohio.)

The average feed cost per cow on 138 dairy farms in the Ohio Farm Business Analysis Summary for 1962 was $105.[6]

Here then is the crux of the proglem - Why are these feed costs as high as they are? What contributes to it?

High costs related to the feeding program will have a direct effect on the cost of milk production. A reduction in feed cost of $10 per cow can result in an increase in income of $400 for a 40 cow herd or of over $1,000,000 for the dairy farms of the seven county area. Likewise, improved utilization of feed might result in an increase in output per cow. If the value of additional milk produced were $10 per cow the result would be similar.

PURPOSE

The purpose of the investigation is to: 1) ascertain if feeding patters influence feed costs and milk yields; and 2) determine possible areas where feeding economies could be effected.

Some of the specific areas studied are feed conbinations, types of feed fed, nutritional balance, and feeding levels in relation to production.

Review of Literature

Feed input cost information for actual farm situations is difficult to find in the literature. Farm account summary reports include

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[6]1962 Farm Business Analysis Report, Department of Agriculture and Rural Sociology, Cooperative Extension Service, The Ohio State University, Columbus, Ohio, p.6.

some information of this type. However, feed inputs are obtained from feed inventory differences rather than from input measurements.

A 1961 study of 43 Michigan mail-in accounting farms conducted by Wright has similar objectives to this study. He found striking variations in costs and returns among the farms included in the study. For example, feed costs per hundred weight of milk produced ranged from $1.30 to $3.03 and milk receipts over feed costs per cow from $75 to $440 annually.

The 10 herds with highest return above feed cost and highest milk production per cow fed the least pounds of total digestible nutrients per cow and least feed cost per cow. According to the feed reports, the herds producing 13,000 pounds or more of milk per cow were fed about 600 pounds more grain concentrate during the year, but approximately the same amount of forages as the herds producing 9,000 pounds or less of milk.

The cows in the large herds, (50 cows and over) were fed more grain and silage per cow but less hay and pasture than the smaller herds (under 30 cows). The feeds fed the larger herds tended to be feeds adapted to mechanical feeding. Wright indicated there was much room for improvement in feeding programs in order to obtain lower feed costs.[7]

In the 1962 Farm Business Analysis for Connecticut Dairy Farms

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[7]Dairy Feed Costs and Returns, 43 Michigan Mail-in Accounting Farms, 1961, K. T. Wright, Department of Agricultural Economics, Michigan State University, East Lansing, pp. 10, 12-15, 18.

George Ecker made the following statement.

> Expenses for purchased dairy feed were the outstanding cost item in all groups. Connecticut dairy farmers usually produce a major portion of their forage requirements and buy dairy concentrates. Home grown forages are generally the lowest cost source of nutrients and it pays dairymen to obtain most of their herds nutrients requirements from this source. Dairymen who can increase their production of forage through the use of more fertilizer, crop selection and harvesting crops at the proper maturity will find this to be a profitable adjustment. This does not eliminate the desirability of purchasing forages or forage substituted under certain conditions. It is profitable to buy these feeds to meet the requirements of the herd if the dairyman is unable to produce additional quantities of forage economically. Every dairyman is continually faced with the program of discovering the most economical source of feed.[8]

L. C. Cunningham, in a New York Study, reported that farmers with high crop yields also had high producing cows. Milk production was highest on farms having purchased high quantities of feeds, but it was profitable to buy additional feed only where high crop yields were obtained.[9]

Thompson, et al., found in an Oklahoma feeding trial that cows fed at the rate of one pound of grain for each eight pounds of milk yielded a greater return over feed cost per hundred weight of milk than did two other groups fed at the rate of one pounds of grain for each three and

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[8] Farm Business Analysis For Connecticut Dairy Farms, Prepared by George A. Ecker, Department of Agricultural Economics and Farm Management, Connecticut Agricultural Extension Service, October 1962, p. 5.

[9] Commercial Dairy Farming, Oneida-Mohawk Region New York 1959-60, L.C. Cunningham, Bulletin 992, Cornell University, Agricultural Experiment Station, New York State College of Agriculture, Ithaca, New York, March 1964, p. 43.

five pounds of milk, respectively.[10]

C. L. Blackman states that feeding standards demonstrate the need of balanced rations. Farmers can use them to determine the nutrients requirements of animals and amounts of grain to feed. In calculating rations an excess of not more than 10 percent of total pounds of digestible nutrients and total pounds of digestible protein should be provided.[11]

SAMPLE AND DATA COLLECTION

Dairy feed input and milk production records were obtained from 40 commercial dairymen in the four county area of Ashland, Holmes, Wayne, and Medina. All of these herds were of the Holstein breed.

The sample of dairymen was selected on the basis of having (1) 75 percent or more of the farm income from dairying, (2) participation in the area farm account program, and (3) willingness to supply feed input information. These dairymen were subjectively evaluated on being above average capability and were typical dairymen on the farm account program.

Cooperators furnished detailed feed input information by months for the year 1964 on forms provided for this purpose. This information was mailed in at the end of each month. Purchased mixed feeds,

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[10] The Effect of Level of Grain Feeding Upon the Efficiency of Milk Production, Eddie L. Thompson, Magnoe, Ronning, and E. R. Berousek, Dairy Department, Oklahoma A. and M. College Experiment Station, Bulletin No. B-483, December, 1956, p. 6.

[11] Feeding Dairy Cattle, G. L. Blackman, Cooperative Extension Service, The Ohio State University, Bulletin 72, p. 31.

supplements, and other ingredients as well as farm produced feeds were reported by each farm cooperator. Detailed information on number of milking cows, dry cows, and youngstick was received along with quanities of feed fed each group by months.

To insure accuracy in reporting cooperators were carefully instructed on completing the forms and on the proceedures for estimating concentrate, silage, green chop and pasture consumed. Quality hay fed was estimated by weighing several bales each month, computing the average weight and reporting the number of bales fed. Silage was estimated by weighing one day's feeding each month, plus the number of days silage was fed. Green Chop forage fed was reported by kind, by number of loads fed, and by weight per load. Pasture was reported by number of days, kind, and an estimate of growth available in the following categories; ample, medium, and short.[12]

Milk weights and dollars of milk sold were obtained at the end of the year from farm records.[13]

All records were edited and checked when received for completness and accuracy. Any descripencies were checked with the cooperator.

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[12]Formula For Calculating Pasture, (1) Quality code figures from EDPM Roughage Quality Sheet used to convert pasture to a standardized "Dry Hay Equivalent" having a quality code of .44. a) appropriate quality code for pasture selected (for example, 1.3 for alfalfa pasture in May. b) since this code is on a per cwt of body size it was multiplied by 10.00 for Jerseys, 11.00 for Guernseys, 12.00 for Ayshires and 14.00 for Holsteins. c) The resulting figure was then divided by .44 (Standardized Hay Code used) to convert to pounds of "Dry Hay Equivalent" consumed per cow per day.

[13]Milk value is net after deducting marketing costs.

LIMITATIONS OF DATA

The analysis of the data in this study is subject to certain limitations in the data obtained and in the techniques used. These are:

(1) Accuracy of the date

The weights of feed inputs are approximate. Direct supervision of the weighting and estimating feed quanities was not possible. Reliance on the accuracy was put on the care with which the cooperators made their estimates.

Quality estimates were not made for the forages fed by the cooperators. Therefore, it was assumed that for the sample the distribution would be normal and that average figures could be used.

(2) Size of Sample

The forty herd sample is not as large as desired in order to obtain the best statistical measurements. The size of various sorts made of the data were necessarily quite small which makes the testing for significance difficult.

(3) Homogeneity of the Data

It turned out that there was a wide variation in the size of herds in the study, the production per cow, and the potential production per cow. This was impossible to control due to the limited number of herds that could be obtained for the study and the geographical area that could be covered to obtain cooperators.

(4) Skill of the Managers

Here again there is probably a wide variation in the skill of the managers which, of course, affects the performance of the herds in the study.

METHODOLOGY

The principle analytical tools utilized in this study were: 1) Frequency sorts based on production per cow, returns over feed cost per hundred weight of milk produced, herd size, and the contribution to total quantity of total digestible nutrients fed; 2) Multiple linear regression as described by Ezekiel and Fox.[14]

The sorts were based on selected inputs as well as outputs and total costs. The sample farms were categorized into terciles so as to have as large a group as possible and enough groups to ascertain patterns.

The multiple linear regression used was $Y = bo + b.X + b_2X_2 + b_3X_3$.

b = constant term
X = dollars of concentrate fed per cow
X_2 = dollars of summer forage (green chop and pasture) fed per cow
X_3 = dollars of stored forage (hay, grass silage, corn silage) fed per cow
Y = pounds of milk produced per cow

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[14]Mordicai Ezekiel and Karl A. Fox, Methods of Correlation and Regression Analysis, 3rd ed., John Wiley and Sons, Inc., New York, 1963, p. 248.
Linear regression is a method of appriximating a function by fitting a straight line to the data to minimize the same of the squared deviations. It may be applied to functions relating a series of independent variables to a single dependent variables.

CHAPTER II

FINDINGS

The 40 sample herds were found to exhibit a wide variation in nearly every factor used in the analysis. Little evidence or pattern of influence could be found in either group average or regression analysis.

The sorts included (1) average feed inputs, costs, and returns, (2) return over feed cost per hundred weight of milk, (3) production of 3.5 percent Fat Corrected Milk per cow, and (4) number of cows in the herd. Other sorts were made but reveal comparable results and are not reported in this paper.

FEED INPUTS, COSTS, AND RETURNS

The 40 herds averaged 43 cows each and ranged from 18 to 104 cows.[15] Milk production per cow varied from 9,824 pounds to 15,428 pounds with an average of 13,260 pounds.[16]

Milk receipts ranged from a low of $387 per cow to a high of $606 per cow with an average of $512 per cow annually.[17] Most of the difference was due to differences in milk production but part was a result of difference in price received per hundred weight. Milk prices

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[15] Includes cows in milk and dry cows. Computed by adding monthly averages of cows in the herds and divided by 12.

[16] Milk production was adjusted on all farms to a 3.5 percent butterfat corrected basis in order to make all milk production figures comparable.

[17] Milk receipts are net after deductions for hauling and marketing costs.

ranged from $3.60 to $4.11 per hundred weight.[18] This range is due to differences in hauling costs and location differentials.

Feed costs per cow averaged $261 and ranged from $186 to $427 for the year.[19] Returns over feed costs had an equally wide range from $122 to $400 per cow with an average of $251. Feed costs averaged 51 percent of total receipts. Average return over feed costs per hundred pounds of milk produced was $1.89 and ranged from $0.88 to $2.70.

The concentrates fed per cow averaged 2,977 pounds which is very close to the average of 3,020 pounds fed per cow in Ohio as reported by the United Stated Department of Agriculture.[20]

A total of 9,476 pounds of TDN (Total Digestible Nutrients) were fed per cow and again a wide variation was found, ranging from 7,757 to 13,160 pounds per cow.[21] Compared to annual requirements for the average cow these sample farms fed 114 percent of TDN requirements and ranged from 90 percent to 150 percent.[22]

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[18]Computed by dividing the dollars of milk sold by the hundred weight of milk sold.

[19]Feed costs were computed on the basis of average prices for 1964 obtained from local feed mills.

[20]Milk Production, United States Department of Agriculture, Statistical Reporting Service, Crop Reporting Board, Washington D. C., May 13,1963, p. 10.

[21]Frank B. Morrison, Feeds and Feeding, 21st ed., The Morrison Publishing Co., 1948, p. 1086 ff. Pounds of Total Digestible Nutrients and Digestible Protein were computed from average content.

[22]Requirements for pounds of Total Digestible Nutrients and Digestible Protein were computed from; C. L. Blackman, Feeding Dairy Cattle, Ohio Extension Bulletin No. 72, p. 31. A figure of .7 pounds of Digestible Protein per day for 60 days and 9 pounds of TDN per day for 60 days for pregnancy requirements. The assumption was made that 25 percent of the herds were heifers needing an additional growth requirement.

The digestible protein feeding levels reveal a similar pattern except for higher extremes in amount fed in excess of requirements. The average quantity fed was 1,380 pounds compared to requirements of 906 pounds or 152 percent. The range was 101 to 234 percent.

Assuming accurate weights of inputs were reported by the dairymen and that the quality of forage was average, these results demonstrate that the sample group of dairymen were feeding at nearly the desired rate of TDN according to production, but were grossly over feeding digestible protein. (Table 7).

Concentrates contributed 38.5 percent of the total pounds TDN fed, while the stored or harvested forage (hay, corn silage, and grass silage) contributed 52.5 percent and green chop plus pasture (summer forages) contributed 19 percent of the total.

RETURNS AND FEED COSTS PER HUNDRED WEIGHT OF MILK

Return over feed cost per hundred weight of milk was used as a basis for sorting the sample herds into the low 13, middle 14, and high 13 herds. (Table 8). For these terciles the average returns over feed cost per hundred weight of milk for the low 13 herds were $1.60, the middle 14 herds were $1.95, and for the high 13 herds were $2.16.

The size of herd was less at the high level of net returns over feed costs per hundred weight than at the low level of returns. Production per cow was higher from the low to the high group by 987 pounds which had a significant influence on receipts which were higher by $44 per cow. Feed costs per cow were less from the low to high groups while returns over feed costs were higher.

TABLE 7
DAIRY COW FEED COSTS AND RETURNS
40 NORTHEASTERN OHIO DAIRY HERDS
1964, (AVERAGE AND RANGE)

	Average (all farms)	Range Low	Range High
Per Farm			
Pounds 3.5 percent F. C. Milk Produced	573,315	252,280	1,387,131
Number of Cows in Herd	43.2	17.8	103.7
Milk Receipts	$22,119	$ 9,553	$55,199
Per Cow			
Pounds 3.5 percent F. C. Milk Produced	13,260	9,824	15,428
Milk Receipts[a]	$ 512	$ 387	$ 606
Feed Cost	$ 261	$ 186	$ 427
Return Over Feed Costs	$ 251	$ 122	$ 400
Pounds Concentrate	2,977	2,794	7,385
Pounds TDN Fed	9,476	7,757	13,160
Computed TDN Requirement	8,319	7,320	9,159
Percent Fed of Requirement	114	90	150
Pounds Digestible Protein Fed	1,380	982	1,891
Computed Digestible Protein Requirement	906	763	1,015
Percent Fed of Requirement	152	101	234
Per CWT			
Milk Receipts	$3.86	$3.60	$4.11
Feed Costs	$1.97	$1.31	$2.92
Net Over Feed Cost	$1.89	$0.88	$2.70
Percent Total Pounds TDN			
Concentrate	38.5	18.6	54.5
Hay	21.1	4.4	51.7
Corn Silage	14.2	0.0	32.7
Grass Silage	7.2	0.0	51.4
Green Chop	13.1	0.0	35.5
Pasture	5.9	0.0	24.6

[a]Marketing costs deducted

TABLE 8

DAIRY FEED COSTS AND RETURNS FOR 40 NORTHEASTERN OHIO DAIRY HERDS, 1964
(RETURNS OVER FEED COST PER HUNDRED WEIGHT OF MILK)

	Low Third	Middle Third	High Third	Difference Low to High
Per Farm				
Pounds 3.5 Percent F. C. Milk Produced	639,311	511,790	530,500	108,811
Number Cows	49.9	41.4	38.5	-11.4
Milk Receipts	$24,677	$21,100	$20,659	$ 4,018
Per Cow				
Pounds 3.5 Percent F. C. Milk Produced	12,800	13,331	13,787	987
Receipts of Milk	$ 494	$ 509	$ 538	$ 44
Feed Cost	$ 290	$ 249	$ 239	- $ 51
Return Over Feed Costs	$ 204	$ 260	$ 299	$ 95
Pounds TDN Fed	10,265	9,078	8,912	1,353
Pounds TDN Required	8,125	8,346	8,538	413
Percent Fed of Requirement	126	109	104	- 22
Pounds Digestible Protein Fed	1,534	1,312	1,240	- 294
Pounds Digestible Protein Required	884	904	935	51
Percent Fed of Requirement	174	145	133	- 41
Per CWT				
Milk Receipts	$3.86	$3.82	$3.89	$ .03
Feed Cost	$2.26	$1.87	$1.73	$ .51
Net Over Feed Cost	$1.60	$1.95	$2.16	$ .56
Percent TDN				
Concentrate	37.0	40.6	38.2	.8
Hay	20.3	22.3	20.7	.3
Corn Silage	14.7	11.6	16.6	1.9
Grass Silage	4.2	10.0	8.5	4.3
Green Chop	18.9	7.5	11.0	-7.9
Pasture	4.9	8.0	5.0	.1

Total pounds of TDN fed per cow was less for the high return group compared to the low return group by 1,353 pounds. For all three groups the quantily of TDN fed exceeded the requirements with an excess of 26 percent for the low return group and only 4 percent for the high return group. This indicated those dairymen with high return herds were feeding closer to the recommended rates according to production or were getting better utilization of the feed fed.

The digestible protein feeding levels show a similar trend to the TDN, except that the quantity fed per cow over requirements is greater. This indicated that excess digestible protein was fed resulting in a high feed cost per cow.

The percentage of TDN contributed by each class of feed shows little trend except that more grass silage was fed in the high net return over feed cost per hundred weight group than the low return group and that more green chop was fed in the low group than in the high group.

By combining hay, corn silage, and grass silage (harvested forage) we find that their total contribution to total TDN was higher for the high return group than for the low return group and by combining green chop and pasture (summer forage) we find their contribution was less for the high return group than for the low return group.

NUMBER OF COWS

The 40 herds were sorted into terciles according to the number of cows in the herd. (Table 9). There was an average of 26.3 cows in the low 13 herds, 38 cows for the middle 14 herds, and 65.7 cows in the high 13 herds, according to number of cows in the herd.

Production per cow was higher in the small herds than in the large herds. Milk receipts were higher in the small herds compared to the large herds by $27 per cow while feed costs were nearly equal between the small and large herds, but the middle group had much lower costs. However, the small- and middle-sized herds has equal returns over feed costs while the large herds had $33 per cow less.

Total pounds of TDN fed per cow was nearly equal between the small and large herds, but was considerably less for the middle-sized herds. Compared to computed requirements, all were feeding over the recommended levels with the middle group of herds being fed an excess of 7 percent over requirement.

The digestible protein fed per cow followed the same pattern as the pounds of TDN, but with excess fed over requirements at a higher level.

The net return over feed cost per hundred weight of milk produced was highest in the middle-sized herds and lowest in the large-sized herds.

The percentage of TDN contributed by concentrates was nearly constant among the groups with the middle-sized herds receiving slightly less. The percentages from hay and pasture was less in the large herds than in the smaller herds, while corn silage and green chop are higher.

TABLE 9

DAIRY FEED COSTS AND RETURNS FOR 40 NORTHEASTERN OHIO DAIRY HERDS, 1964
(NUMBER OF COWS IN HERD)

	Low Third	Middle Third	High Third	Difference Low to High
Per Farm				
Pounds 3.5 Percent F. C. Milk Produced	362,823	506,599	855,655	492,832
Number Cows	26.3	38.2	65.7	39.4
Milk Receipts	$13,983	$19,497	$33,080	$19,097
Per Cow				
Pounds 3.5 Percent F. C. Milk Produced	13,806	13,278	13,031	-775
Receipts of Milk	$532	$511	$505	-$27
Feed Cost	$265	$245	$271	$ 6
Return Over Feed Costs	$267	$266	$234	$33
Pounds TDN Fed	9,607	8,932	9,763	158
Pounds TDN Required	8,562	8,360	8,195	467
Percent Fed of Requirement	112	107	119	7
Pounds Digestible Protein Fed	1,364	1,306	1,432	68
Pounds Digestible Protein Required	937	912	889	-48
Percent Fed of Requirement	146	143	161	15
Per CWT				
Milk Receipts	$3.85	$3.85	$3.87	$.02
Feed Cost	$1.92	$1.84	$2.07	$.15
Net Over Feed Cost	$1.93	$2.01	$1.80	-$.13
Percent TDN				
Concentrate	39.7	35.9	39.4	- .3
Hay	29.4	22.1	17.3	-12.1
Corn Silage	10.0	15.2	15.5	5.5
Grass Silage	7.4	9.9	5.6	- 1.8
Green Chop	3.3	11.3	17.9	-16.6
Pasture	10.2	5.6	4.2	- 6.0

By combining hay, corn silage, and grass silage (harvested forage) we find that the percentage of pounds of total digestible nutrients furnished is smaller by 8.4 percent in the large herds than the small herds, while the percentage of green chop and pasture (summer forage) is 8.6 percent higher in the larger herds than in the small herds.

This sort indicated that the small and middle-sized herds obtained better results than the small or large herds. The larger herds exhibited a different pattern of forage feeding than the small herds depending more on green chop.

POUNDS OF 3.5 PERCENT FAT CORRECTED MILK PER COW

Table 10 shows that the low 13 herds in milk production per cow averaged 11,821 pounds of milk, the middle 14 averaged 13,533 pounds of milk, and the high 13 averaged 14,803 pounds of milk.

The results show a pattern that might be expected with higher milk receipts, feed costs, return over feed costs, and quantities of TDN fed at higher levels of production. However, returns over feed cost per hundred weight of milk produced were almost identical with a range of only five cents from the low production group to the high production group in milk production per cow. This indicates that higher production is not necessarily more efficient than lower production.

The feeding system shows a higher proportion of TDN coming from concentrates between the low and high production group by 8 percent and a smaller proportion coming from green chop by 9.2 percent.

TABLE 10
DAIRY FEED COSTS AND RETURNS FOR 40 NORTHEASTERN OHIO DAIRY HERDS,1964
(POUNDS OF MILK PER COW)

	Lower Third	Middle Third	High Third	Difference Low to High
Per Farm				
Pounds 3.5 Percent F. C. Milk Produced	542,831	624,657	527,737	-15,094
Number Cows	47.7	46.2	35.7	12.0
Milk Receipts	$21,758	$24,177	$20,264	$ 1,492
Per Cow				
Pounds 3.5 Percent F. C. Milk Produced	11,821	13,533	14,803	2,982
Receipts of Milk	$456	$524	$568	$112
Feed Costs	$242	$264	$283	$ 41
Returns Over Feed Costs	$214	$260	$285	$ 71
Pounds TDN Fed	8,925	9,743	9,839	914
Pounds TDN Required	7,870	8,372	8,843	973
Percent Fed of Requirement	113	116	111	- 2
Pounds Digestible Protein Fed	1,304	1,435	1,404	100
Pounds Digestible Protein Required	846	919	966	120
Percent Fed of Requirement	154	156	145	- 10
Per CWT				
Milk Receipts	$4.01	$3.87	$3.84	- $.17
Feed Cost	$2.13	$1.95	$1.91	- $.22
Net Over Feed Cost	$1.88	$1.92	$1.93	$.05
Pounds TDN	78.4	72.0	66.4	- ..12
Pounds Digestible Protein	11.4	10.6	9.5	- 1.9
Percent TDN				
Concentrate	34.9	38.4	42.1	7.2
Hay	21.5	20.8	22.6	1.1
Corn Silage	14.1	12.9	12.8	1.3
Grass Silage	7.9	6.3	7.7	- .2
Green Chop	16.1	15.7	6.9	-9.2
Pasture	5.5	5.9	7.6	2.1

INFLUENCE OF INDIVIDUAL FEEDS

Regression analysis was used to ascertain the influence of each of the feed components on output of milk, receipts per cow from milk sold, total feed cost, and return over feed cost per cow. None of the individual feed componets was found to have significant influence on these dependent variables.

Feed inputs were sorted into summer and winter feeding periods (November through April for winter, and May through October for summer). Again a regression analysis was used to determine the influence of individual feed inputs on production per cow, milk receipts, feed costs per cow, and return over feed cost per cow. These sorts also failed to reveal significant influence by any of the individual feeds.

TABLE 11
MILK PRODUCTION AND RETURNS OVER FEED COST FROM HERDS RECEIVING FIFTEEN PERCENT OR MORE FROM SELECTED FORAGES, 40 NORTHEASTERN OHIO DAIRY HERDS, 1964
(LOW TO HIGH RETURN OVER FEED COST PER CWT MILK)

Forage	Milk Per Cow[1] (pounds annually)	Return Over Feed Costs	
		Per Cow	Per CWT Milk
Green Chop (18 herds)	12,084	$216	$1.79
Hay (32 herds)	13,467	$255	$1.89
Corn Silage (15 herds)	13,273	$255	$1.92
Grass Silage	13,044	$265	$2.03

[1] 3.5 percent FCM Milk.

TOTAL DIGESTIBLE NUTRIENTS FROM FORAGE

Forages are the basic feeds for dairy cattle and supply a low cost source of protein and total digestible nutrients (see Ecker, page 15 of this report). Accordingly sorts were made to determine the influence of total pounds of TDN from forages on production per cow, returns over feed cost per cow and returns over feed cost per hundred weight of milk produced.

The thirteen herds receiving 15 percent or more of the nutrients in grass silage produced 13,044 pounds of milk with an annual return of $265 per cow over feed cost and $2.03 per hundred weight of milk over feed cost. (Table 11).

Eithteen herds receiving 15 percent or more of the nutrients in the ration from green chop produced 12,084 pounds of milk with an annual return of $216 per cow over feed cost and $1.29 per hundred weight of milk over feed cost. (Table 11).

Fifteen herds receiving corn silage at the rate of 15 percent or more of the nutrients in the ration produced 13,273 pounds of milk per cow annually with returns of $255 over feed cost per cow and $1.92 over feed cost per hundred weight of milk. (Table 11).

Thirty two herds receiving 15 percent or more of their total nutrients from hay produced an average of 13,467 pounds of milk per cow with returns of $255 over feed cost per cow and $1.89 over feed cost per hundred weight of milk. Herds at higher levels of input had results comparable to those above.

Farmers feeding large quantities of hay achieved the highest milk production per cow. However, the highest returns over feed cost per cow was attained by farmers feeding large quantities of grass silage.

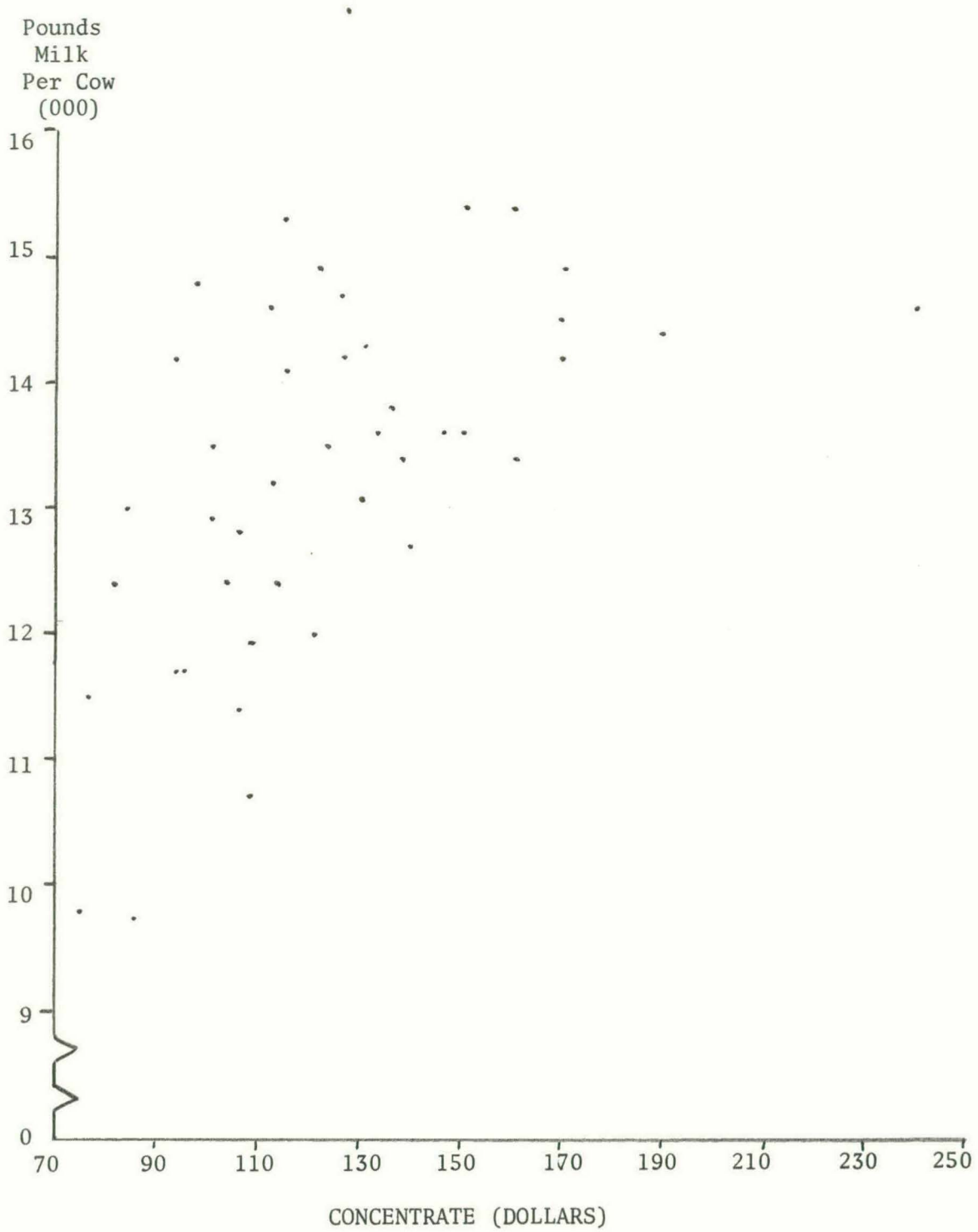
INFLUENCE OF CONCENTRATES, HARVESTED FORAGE, AND SUMMER FORAGE

Costs of individual feed inputs were classified into concentrates, harvested forage (hay, corn silage, grass silage), and summer forage (green chop and pasture). Examination of scatter diagrams showing the relationship between dollars of input and milk production for concentrates, harvested forage, summer forage, and forage reveals that concentrates did show a relationship. As the dollars of concentrates was increased there was an increase in pounds of milk produced (Figure 2). The forages did not show any positive relationships (see appendix figures

Dollars of Concentrates, harvested forage, and summer forage were measured according to three summer feeding systems; herds using pasture but no green chop; green chop and pasture; and green chop and/or pasture to determine if an influence could be found on milk production per cow and feed cost per hundred weight of milk. There were 35 herds included in this analysis. Two herds using haylage, and three herds using no green chop or pasture were eliminated in order to have a more homogeneous group.

Table 12 shows average feed costs, milk production, and returns over feed costs per hundred weight of milk produced in relation to the feeding systems used. Although there were varying amounts of concen-

FIGURE 2
POUNDS OF 3.5 PERCENT F.C. MILK PER COW, BY DOLLARS OF CONCENTRATE FED PER COW, ON 40 NORTHEASTERN OHIO DAIRY FARMS, 1964.



trates, summer forage, and harvested forage used for the three systems, the feed costs were nearly equal. The conbination green chop and pasture produced the lowest milk production per cow while those using pasture but no green chop had the highest yields.

TABLE 12
FEED COSTS AND PRODUCTION PER COW BY THREE SUMMER FORAGE FEEDING SYSTEMS FOR 35 NORTHEASTERN OHIO DAIRY FARMS
1964

	Green Chop and/or Pasture (35 Herds)	Green Chop and Pasture (23 Herds)	Pasture only (12 Herds)
Concentrate	$128.13	$122.07	$136.20
Summer Forage[1]	$ 31.31	$ 42.85	$ 15.93
Harvested Forage[2]	$103.95	$ 96.37	$114.05
Total Feed	$263.17	$261.40	$265.53
Pounds Milk	13,460	13,095	13,947
Feed Cost Per CWT of Milk	$1.95	$2.00	$1.90

[1]Green chop and pasture

[2]Hay, Grass Silage, Corn Silage

TABLE 14
COEFFICIENTS OF SELECTED FACTORS RELATED TO MILK PRODUCTION PER COW
BY THREE SUMMER FORAGE FEEDING SYSTEMS
35 FARMS, NORTHEAST OHIO, 1964
(HUNDRED WEIGHTS OF MILK)

Factor	35 Farms Green Chop and/or pasture			20 Farms Green Chop and Pasture			15 Farms Pasture only		
	Regression Coeff.	Correlation	t value	Regression Coeff.	Correlation	t value	Regression Coeff.	Correlation	t value
Concentrates	.251	.585	4.80[a]	.287	.628	4.41[a]	.261	.383	2.06[b]
Summer Forages[1]	-.213	-.297	-2.34[a]	-.310	-.149	-2.58[a]	-.009	-.119	-.025
Harvested Forages[2]	.037	.109	.400	-.131	-.136	-.904	.213	.123	1.35
	R Square - .478 F Test For R - 9.45[a]			R Square - .574 F Test For R - 7.19[a]			R Square - .293 F Test For R - 1.52		

[a]significant at the 5 percent level

[b]significant at the 10 percent level

[1]includes Green Chop and Pasture

[2]includes Grass Silage, Corn Silage, Hay

The regression analysis of the 35 herds using green chop and/or pasture in their summer forage program shows that for each additive, $1.00 of concentrates fed there is an additional 25 pounds of milk produced; for each $1.00 additional summer forage fed there is a decrease in milk production; and there was no significant influence for harvested forage. Forty-eight percent of the variation in input was explained by these three classification of feeds.

For those herds using green chop and pasture a $1.00 increase in concentrates fed resulted in a twenty-nine pound increase in milk production. An addition to summer forage fed results in a decrease in milk yield and there is no significant influence by harvested forage. Fifty-seven percent of the variation in inputs is explained by these feeds.

For the fifteen herds with pasture, but no green chop, for each additional dollar of concentrates fed a return of an additional twenty-six pounds of milk could be expected. The influence of summer forage and harvested forages was not significent.

CHAPTER III

CONCLUSIONS, SUMMARY, RECOMMENDATIONS

CONCLUSIONS

The wide variation in feed costs and returns of the 40 sample herds indicates that opportunities exist for improvement in dairy feeding programs that will lower feed costs and/or increase returns over feed cost. This is in accord with a conclusion reported by Wright in a Michigan study. (See page 14).

These dairymen were found to have fed an excess of digestible protein and an excess amount of total digestible nutrients when compared to feed recommendations. Economies could be effected by improving the balance of total digestible nutrients and digestible proteins. Following a recommended ration and purchasing farm produced forage and grains could improve the feed-milk transformation.

A positive correlation between quantities of concentrate and milk produced was found to exist on these farms. Farmers feeding large quantities of green chop were found to have less milk production per cow than those feeding large amounts of hay and pasture. Dairymen need to evaluate the use of a green chop program with care. Large quantities of grain can be profitably utilized , but the protein balance of the ration is of extreme importance for an efficient feeding program.

The only clear cut relationship found between the feeds fed and returns was the influence of total concentrates on milk production per

cow. No other reliable statistical inference could be made. This exists because of the extremely wide variations in feeding programs and milk response found on these farms.

SUMMARY

The dairy cow and the production of milk has been, and will continue to be, an important part of the agricultural farm economy of Ohio. This is true because of Ohio's climate, soils, and topography which makes the state suitable for dairy production; and its location in relation to population and the large market demand for dairy products.

There have been many changes in the dairy industry from pioneer days to the present time. Numbers of cows in a herd, methods of handling of feeds, methods of feeding, feeding programs, milking technique, and methods of housing the cows has undergone many changes. Further changes are anticipated, such as increased mechanization, housing, feed quality, and specialization in the milking and feed production functions.

The profitability of the dairy enterprise depends on the relationship of production costs and receipts. Feed costs make up a major portion of the cost of production and are the object of this study. The study was an attempt to determine if there was in fact differences in feeding systems that influenced feed costs in milk production.

Feed input data was obtained from 40 dairy herds in Ashland, Holmes, Medina, and Wayne Counties. The farms were selected on the basis of: 1) seventy-five percent or more of farm income came from dairying; 2)

participation in farm account record program; and 3) willingness of the farmers to provide feed input and milk production information.

Two methods of analysis were used; group sorts to determine any patterns of feeding that effected feed costs and returns, and regression analysis to determine the influence of the individual feeds on costs and returns.

A wide variation in feed inputs and milk outputs was found for the 40 herds included in the sample. This variation exists for both absolute inputs and outputs and in the range of inputs in relation to outputs at various levels of production.

Tercile sorts (low, middle, and high) of return over feed costs per hundred weight of milk produced indicate that the 13 farmers having the highest returns had higher milk production per cow, provided a smaller quantity of nutrient intake, and more closely approximated the recommended ration than the low or middle terciles.

Sorts by number of cows in the herd revealed that the small herd tercile, averaging 26 cows, had the highest production per cow. Returns over feed cost per hundred weight of milk produced were highest in the middle tercile group, averaging 38 cows, and these were fed rations appriximating the computed requirements.

The tercile of large herds averaging 66 cows fed larger amounts of green chop.

Sorts by milk production per cow show that high production levels and milk receipts were associated with high return over feed costs, and

quantities of TDN fed. However, the returns over feed cost per hundred weight of milk produced were almost identical among the three terciles.

A correlation between the level of concentrate feeding and milk production was found in the regression analysis. A depressing effect on milk production at higher levels of summer forage fed was also found. The differences found in the relative quantities of harvested forage fed was not statistically significant.

RECOMMENDATIONS

More study needs to be done on the feed costs component of total feed costs found under actual farm conditions. Some measure of forage quality needs to be included in order to determine with more precision the relationship between pounds of digestible protein and pounds of total digestible nutrients fed and the requirements for the level at which the cows are producing. Also, some means needs to be found to insure accuracy of weights of feed fed as reported by the farmers.

Data needs to be obtained on the effect on milk production costs of overfeeding of total digestible nutrients and digestible protein.

The afore mentioned kinds of information are needed as a teaching tool in working with dairymen in order to demonstrate the advantages of close control of their feeding programs.

APPENDIX

FIGURE 3

POUNDS OF 3.5 PERCENT F.C. MILK PER COW, BY DOLLARS OF PASTURE FED PER COW, ON 36 NORTHEASTERN OHIO DAIRY FARMS, 1964

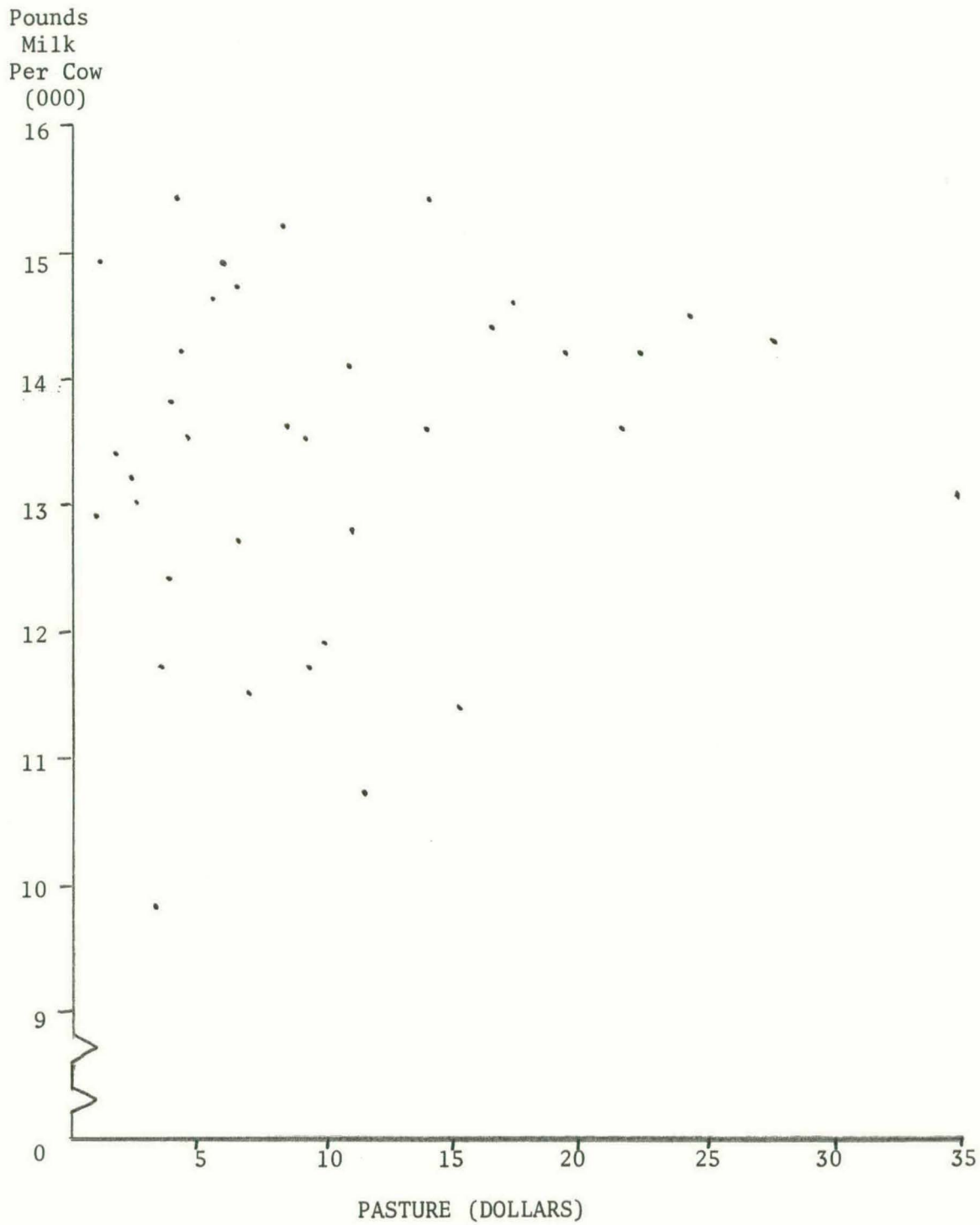


FIGURE 4

POUNDS OF 3.5 PERCENT F.C. MILK PER COW, BY DOLLARS OF HARVESTED FORAGE FED PER COW, ON 40 NORTHEASTERN OHIO DAIRY FARMS, 1964

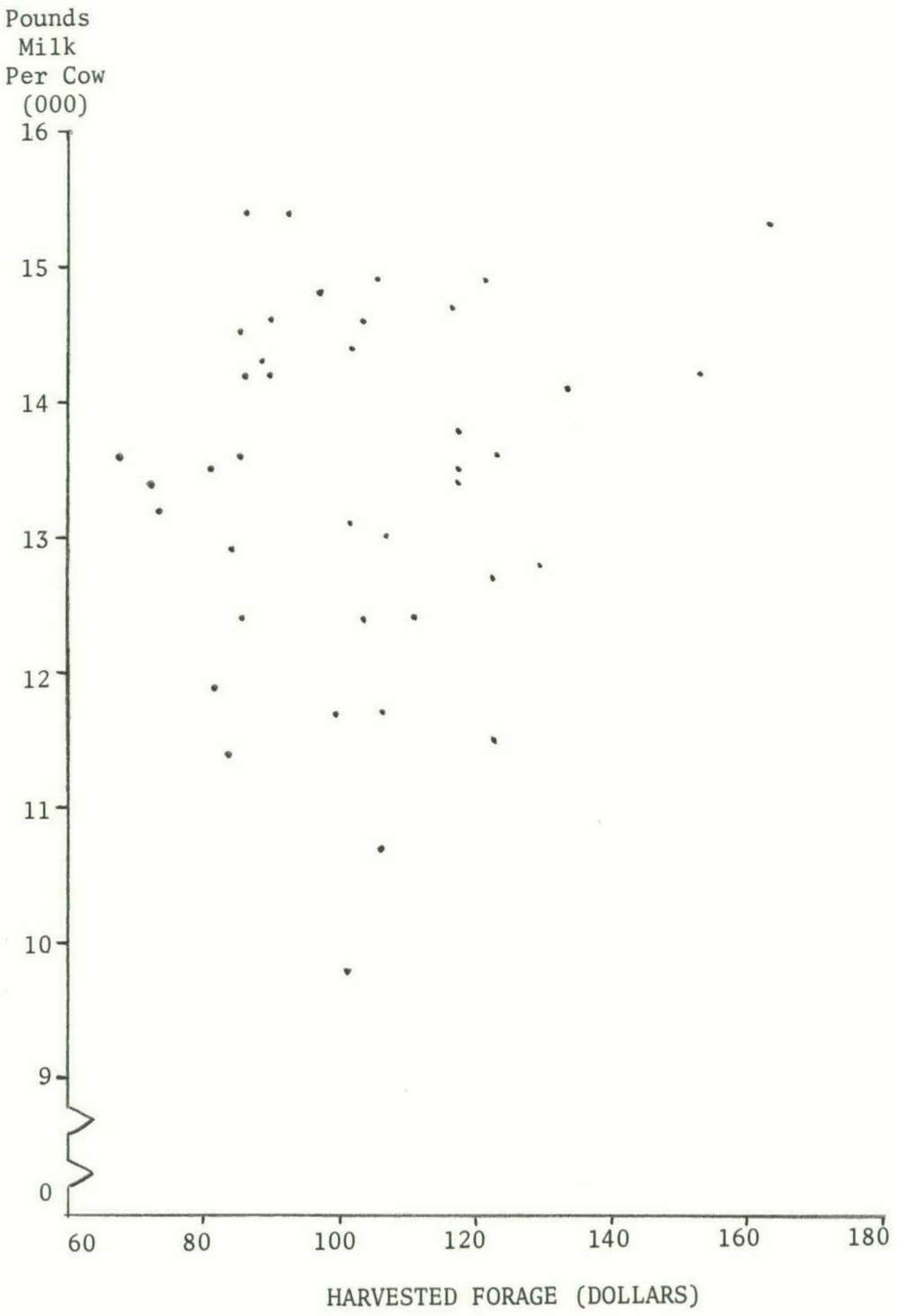


FIGURE 5

POUNDS OF 3.5 PERCENT F.C. MILK PER COW, BY DOLLARS OF TOTAL FORAGE FED PER COW, ON 40 NORTHEASTERN OHIO DAIRY FARMS, 1964

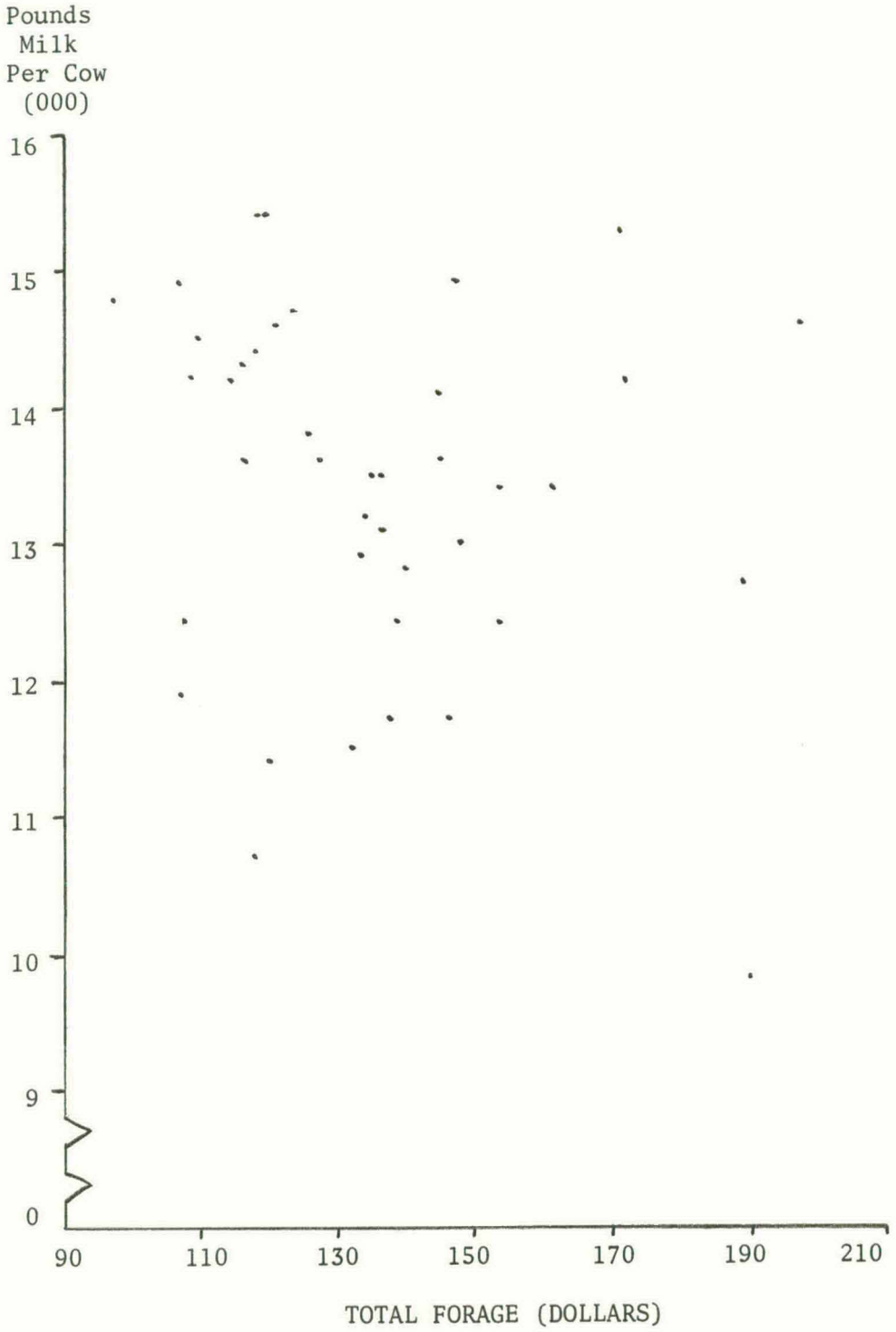


FIGURE 6

POUNDS OF 3.5 PERCENT F.C. MILK PER COW, BY DOLLARS OF GREEN CHOP FED PER COW, ON 23 NORTHEASTERN OHIO DAIRY FARMS, 1964

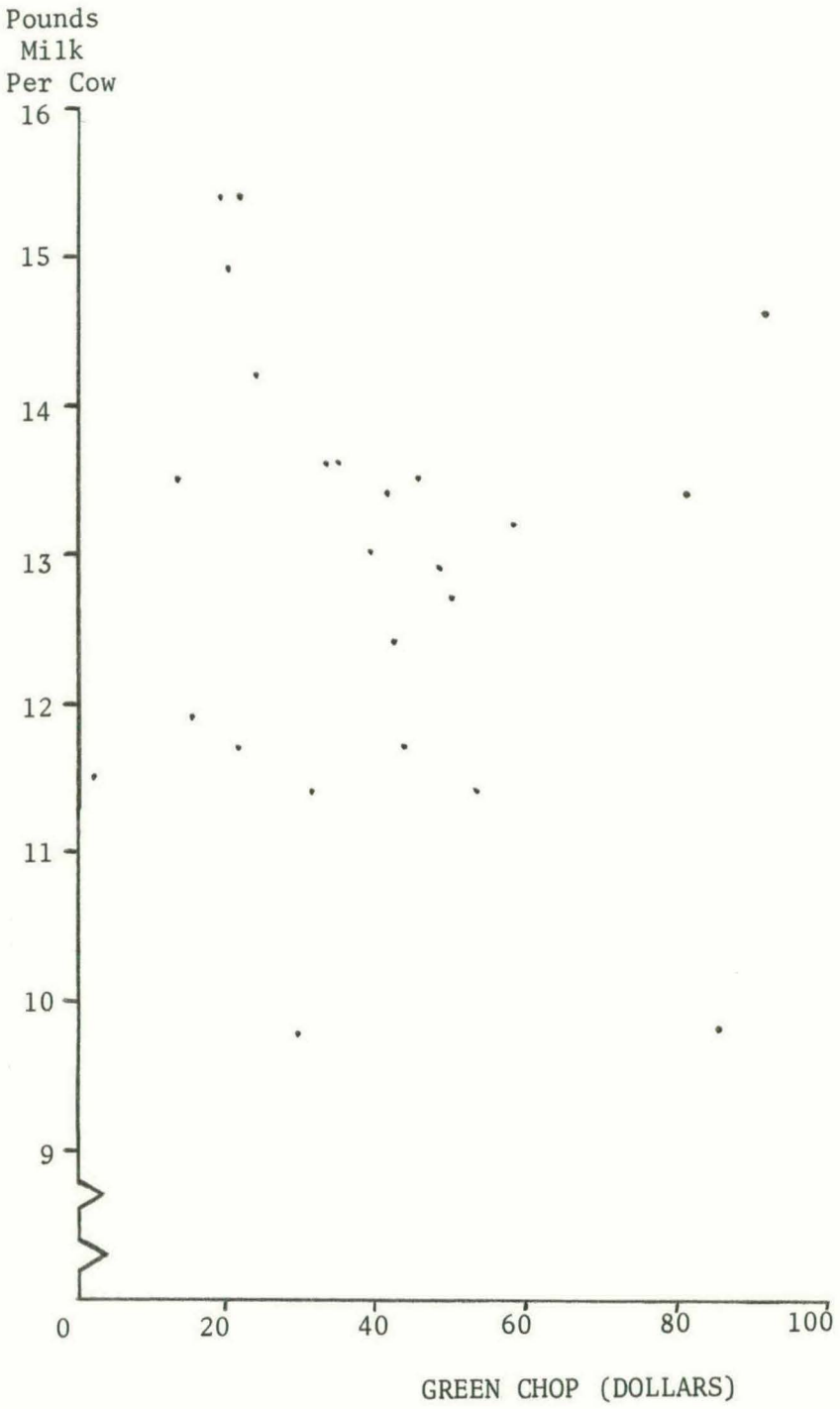


FIGURE 7

POUNDS OF 3.5 PERCENT F.C. MILK PER COW, BY DOLLARS OF GREEN CHOP AND PASTURE FED PER COW, ON 39 NORTHEASTERN OHIO DAIRY FARMS, 1964

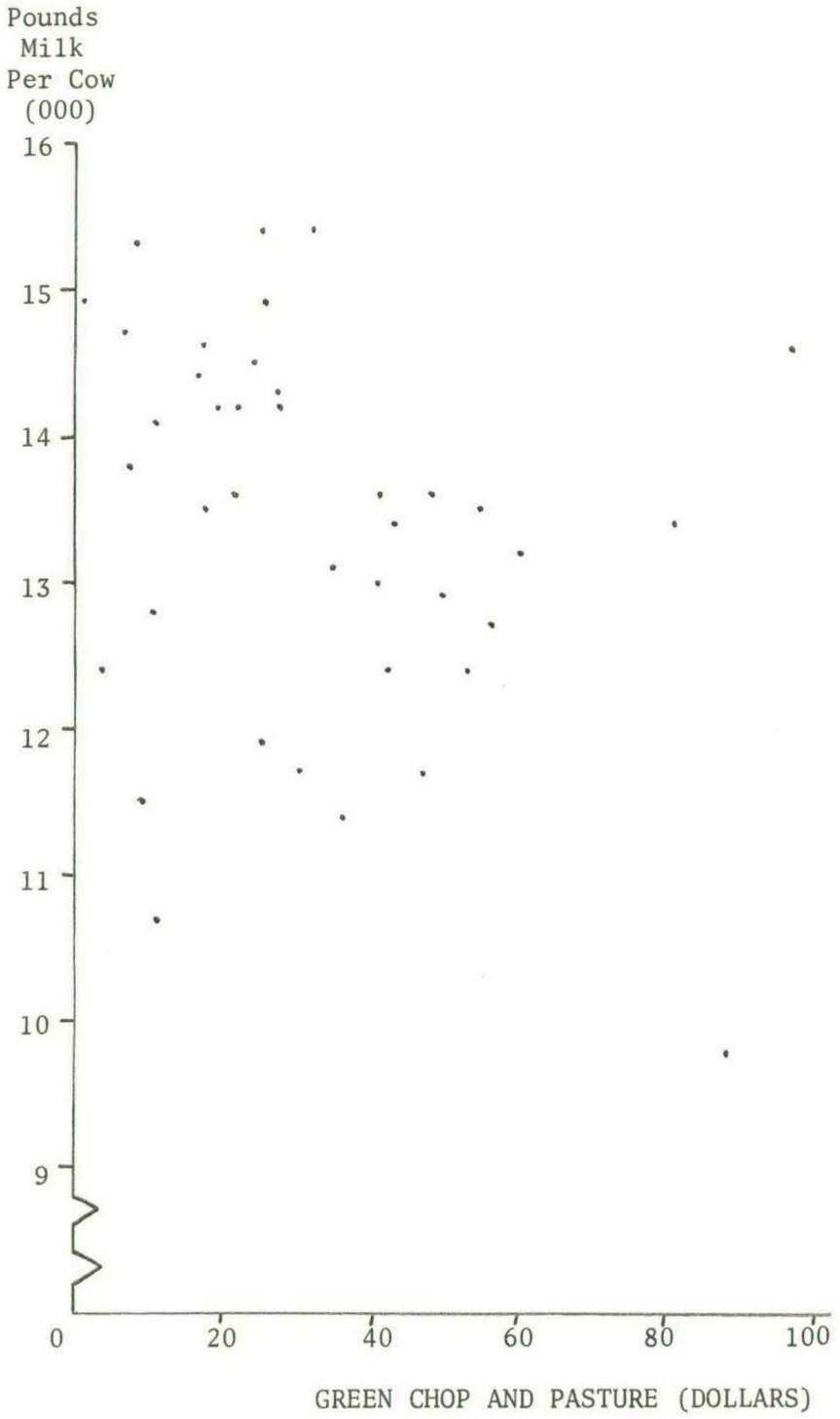
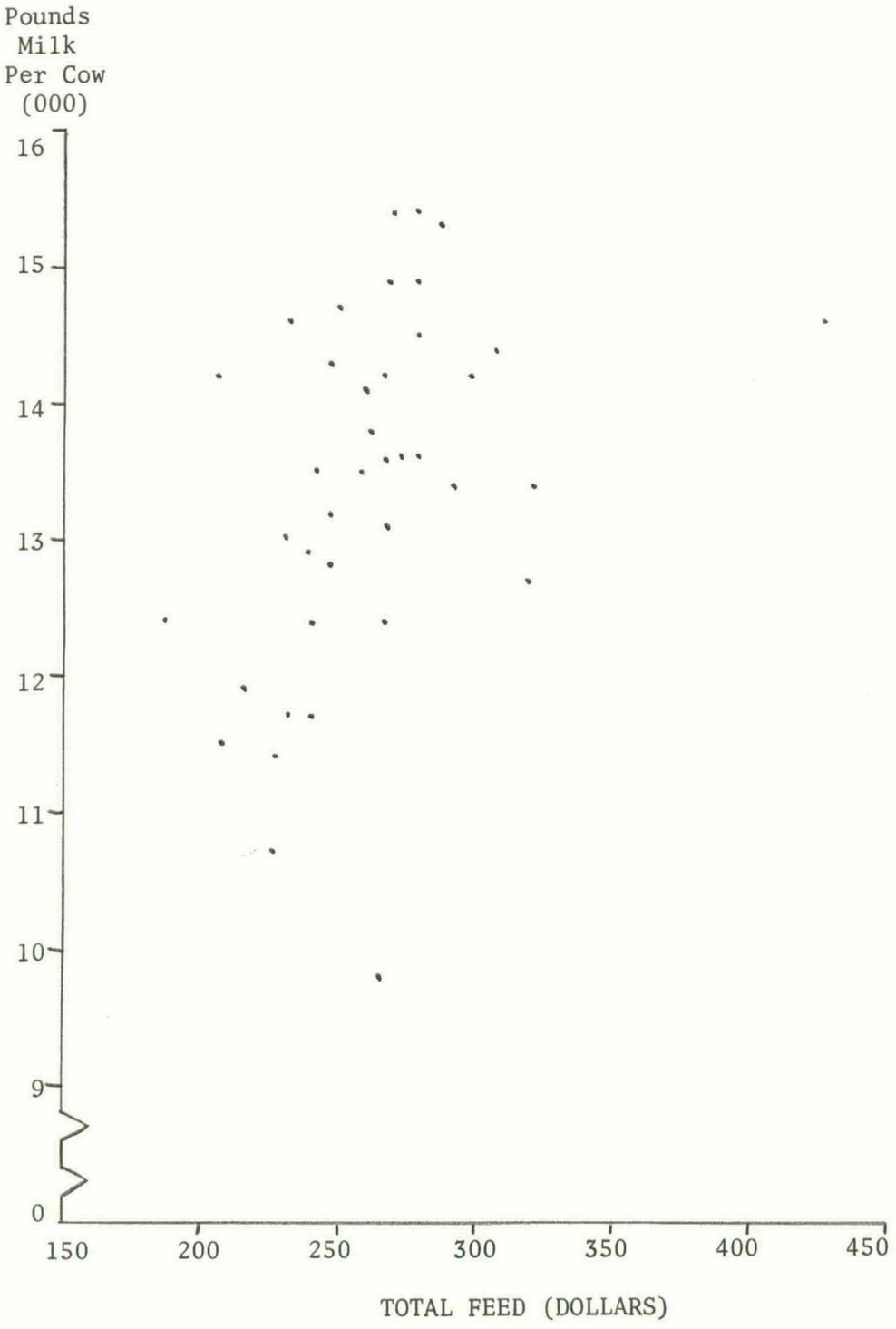


FIGURE 8

POUNDS OF 3.5 PERCENT F.C. MILK PER COW, BY DOLLARS OF TOTAL FEED FED PER COW ON 40 NORTHEASTERN OHIO DAIRY FARMS, 1964



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